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Reliability and Validity of the System for Observing Children’s Activity and Relationships During Play (SOCARP)

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Background: Children frequently engage in diverse activities that are broadly defined as play, but little research has documented children’s activity levels during play and how they are influenced by social contexts. Assessing potentially modifiable conditions that influence play behavior is needed to design optimal physical activity interventions. Methods: System for Observing Children’s Activity and Relationships during Play (SOCARP) was developed to simultaneously assess children’s physical activity, social group sizes, activity type, and social behavior during play. One hundred and fourteen children (48 boys, 66 girls; 42% overweight) from 8 elementary schools were observed during recess over 24 days, with 12 days videotaped for reliability purposes. Ninety-nine children wore a uni-axial accelerometer during their observation period. Results: Estimated energy expenditure rates from SOCARP observations and mean accelerometer counts were significantly correlated \( r = .67; P < .01 \), and interobserver reliabilities (ie, percentage agreement) for activity level (89%), group size (88%), activity type (90%) and interactions (88%) met acceptable criteria. Both physical activity and social interactions were influenced by group size, activity type, and child gender and body weight status. Conclusions: SOCARP is a valid and reliable observation system for assessing physical activity and play behavior in a recess context.

Keywords: recess, direct observation, school

Regular physical activity engagement is an integral component of a healthy lifestyle. Children’s habitual physical activity has been found to be inversely related to metabolic syndrome\(^1\) and the clustering of cardiovascular risk factors,\(^2\) and it is positively related to physical fitness\(^1\) and bone mineral density.\(^3\) Furthermore, a physically active childhood may benefit adult physical activity levels\(^4\) and health,\(^5\) though weak correlations have been reported.

Many diverse behaviors that children engage in can broadly defined as “play”\(^6\); and these activities are multidimensional and consist of behavioral, motivational, and contextual components.\(^7,8\) Play has an important role in the emotional, cognitive, motor, social, and physical development of children, and it helps them to learn about and interact with their physical and social environment.\(^9\) In addition, play is arguably the most natural way for children to be active due to its vigorous physical activity component.\(^8,10\) There is, however, concern that play opportunities are becoming increasingly restricted,\(^11\) and this negatively impacts children’s development of lifelong skills\(^12\) and their health and physical activity levels.

School recess is a primary context where children can engage in play with peers in a safe environment.\(^13\) Children’s physical activity levels in this setting have been assessed using heart rate,\(^14,15\) accelerometry,\(^16,17\) and direct observation.\(^18,19\) Of these methods, direct observation is particularly useful because it allows for the social and physical contexts of physical activity to be recorded simultaneously.\(^20\) Only 1 direct observation system to date, however, has been developed to assess children’s physical activity levels and play behaviors in a group setting, and this is for use in preschools.\(^21\) With the increasing recognition of recess as an important location for promoting physical activity and positive play behavior,\(^22\) there is need for validated systems to examine factors that may influence children’s physical activity, including the activities they engage in (mode), the size of the social group they play with, and their interactions with others.\(^22\) These factors are potentially modifiable, and they could...
impact children’s physical activity levels. It is important, therefore, to assess the occurrence of these factors and their relationships with physical activity to further current knowledge and to contribute to the design of future recess and other playground interventions.

The current study had 2 aims: a) to develop a systematic observation system for assessing children’s physical activity levels, social group sizes, play activities, and social behavior during play (System for Observing Children’s Activity and Relationships during Play—SOCARP), and b) to conduct an exploratory investigation to determine the reliability and validity of using SOCARP to assess children’s physical activity and play behavior during school recess.

**Method**

**Observation Instrument**

SOCARP was designed for the simultaneous observation and recording of children’s physical activity levels, social group sizes, activity type, and social interactions during play. The system was developed specifically for recess on school playgrounds, but it could be applied to a wide range of both structured and unstructured play settings.

SOCARP uses time sampling techniques during which a 10-second observation interval is followed by a 10-second recording interval for each targeted child.

Before an observed recess period, randomly selected children who are representative of the population under study are identified as targets for observation. The number of children selected depends on the length of the recess period and the study goals. For each child that is selected, a second one is identified as a potential replacement in case the original child does not become available on the playground. Once recess has commenced, the selected child is located and his/her gender, child ID, target code, and observation start time are recorded. Using observations paced by audio cues from an MP3 player, the target child’s activity level, social group size, activity type, and social interactions are observed during each 10-second observe interval and recorded during the 10-second record interval. At the end of the observation period, the availability of equipment (yes/no), the number of adults supervising recess, and the time the observation ended for that child are recorded. Figure 1 provides an example of an abbreviated scoring form, and a full description of the SOCARP codes and measurement protocol is available from the lead author.

![Figure 1](image-url) — Sample SOCARP coding form.
Settings and Observation Schedule

Data were collected in 8 elementary schools in a large city in the North West of England. The schools were participating in the Active City of Liverpool, Active Schools and SportsLinx (A-CLASS) project. This project is a longitudinal, multidisciplinary study of the effects of after-school clubs and a lifestyle intervention on overweight children’s recess and daily physical activity, fundamental movement skills, and laboratory-conducted markers of health. The research design and protocol received approval from the University Ethics Committee and permission to observe was granted by individual schools.

Each school was visited on 3 consecutive days during June and July 2007 (total = 24 days), during which the average temperature was 14.1 °C for each month.23 Each school had 1 tarmac playground that the children could access throughout morning, lunch, and afternoon recesses during all weather conditions except heavy rain. Each playground had existing markings, and while not identical, had common features such as hopscotch, snakes and ladders, number squares, and painted targets. During recess, numerous pieces of manipulative sports equipment such as soccer balls, jump ropes and tennis balls were available frequently. If available, this equipment was accessible to both boys and girls of all ages. In these cases, equipment availability was recorded (YES) and the type of equipment recorded as additional descriptive information. NO was recorded if no portable equipment was provided.

School staff supervised all recess periods. Teachers supervised the morning and afternoon recess periods, and specially employed assistants supervised lunch recess. Supervision generally involved managing the playground environment in relation to safety, and in general there were few interactions between children and staff. The supervisors did not arrange or lead play activities, and intervened only when concerned about safety. The number of adults providing supervision was recorded at the end of each child observation and used in subsequent analyses.

On each observation day, the primary author arrived at the school before morning recess and completed an inventory to assess the playground environment and determine precise recess times. Five minutes before a scheduled recess, an observer recorded the temperature using a standard thermometer (GH ZEAL Ltd, London, UK) at the middle of the playground. At each school this point was centrally located where children would play and was not under cover or in the shade. Temperatures during recess ranged from 12 to 27 °C.

The target children for the study were selected through the A-CLASS Project outlined previously. At the start of recess, a target child was identified and the SOCARP observation schedule initiated. The target child was observed for 10 consecutive minutes (ie, 3 observations/min for 10 min of observation = 30 intervals) before the focus was shifted to the next target child. The number of children selected and observed each session was dependent on the length of the recess period. During 12 days, observations were conducted “live” with the observer standing on the playground and entering data immediately. On the other 12 days, the child was videotaped using a DV tape recorder (3CCD Handycam, Sony Corporation, Japan) and the tapes were later analyzed in the university laboratory.

In addition to being observed, the target children visited the university laboratory where markers of health and anthropometric measures were assessed. Measurements of body mass (to the nearest 0.1 kg) and stature (to the nearest 0.1 cm) were recorded using analog Seca scales (Seca Ltd, Birmingham, UK) and the Leicester Height Measure (Seca Ltd, Birmingham, UK). Overweight was defined using the age and sex-specific ≥85th percentile for BMI of the UK reference values.24

Observer Training

All data were collected by the primary author and 1 additional trained observer. Observer training included becoming familiar with the study protocol, memorizing observational categories and codes, using instrument notation, and being able to discriminate among variables related to activity levels group size, play activities, and social behavior. Observers practiced coding using video-taped examples of recess activity and behavior, and received feedback on the results. This was followed by an assessment of the observer’s reliability by coding videotaped examples of children simultaneously and independently of the primary author. Interobserver agreement criteria were set at >80% using interval-by-interval agreement for each category. Initial training required 25 hours to reach acceptable interobserver agreement.

Reliability

Twelve of the 24 measurement days (50%) were video-taped for intra- and interobserver reliability purposes. To establish intraobserver reliability, the primary author observed and coded 20% (n = 14) of the children videotaped on 2 occasions at least 1 week apart. Intraobserver agreement scores for the assessed variables were 87% for activity level, 85% for group size, 93% for activity type, and 87% for interactions.

To establish interobserver reliability, the 2 observers coded an additional 40% (n = 27) of the videotaped children simultaneously and independently of each other. Interobserver agreements for the assessed variables were 89% for activity level, 88% for group size, 90% for activity type, and 88% for interactions. It was concluded that intra- and interobserver met acceptable criteria for reliability purposes.

Validity

The SOCARP activity codes have been used in observation systems previously: BEACHES (Behaviors of Eating and Activity for Children’s Health: Evaluation System)25
and SOFIT (System for Observing Fitness Instruction Time).26 Construct validity has been determined for the activity codes using heart rate monitoring.25,26

To establish field validity of the activity codes, children in the current study wore a uni-axial accelerometer (GT1M Model, Actigraph, Florida, USA) during the recess periods in which they were observed. The accelerometer was programmed to record physical activity data every 5 seconds, and was worn on the right side of the hip using a tightly fitted elastic belt. At the end of the data collection, all data were downloaded using the Actilife Lifestyle Monitoring System (Version 2.1.8, Actigraph).

Data Analysis

Validity. Accelerometer data matching the start and stop times for the observation periods for each child were extracted using customized macros. Average accelerometer counts for each child (counts per epoch [CPE]), defined as the summed accelerometer counts during the observation period divided by the number of epochs in the observation period) were obtained for use in the analyses. To estimate energy expenditure rate (kcal/kg/min), the number of intervals each child was observed in each of the activity codes (1 = Lying down, 2 = Sitting, 3 = Standing, 4 = Walking, 5 = Vigorous) were summed, and multiplied by the constants 0.029, 0.047, 0.051, 0.096, and 0.144 kcal/kg/min, respectively. These energy expenditure estimates were derived from a previous study.26 Pearson’s correlation coefficients were used to determine the relationship between estimated energy expenditure scores and the accelerometer output.

SOCARP Data

Activity Variables. The percentage of time that each child spent engaged in lying down, sitting, standing, walking, and vigorous activity codes were determined. In addition, the proportion of time that each child spent engaged in sedentary activity and moderate-to-vigorous physical activity (MVPA) was determined. Sedentary activity was defined as the sum of the lying down, sitting, and standing activity categories, while MVPA was created by summing the walking and vigorous categories.

Play Activity and Social Behavior. Contextual variables included the number of supervisors, availability of equipment (YES/NO), and temperature. In addition, for the play activities and social behaviors, the proportion of intervals/time spent in each group size, activity type, and type of social interactions by the target child were determined. Analyses of variance (ANOVA’s) were used to compare differences between boys and girls and between normal and overweight children on all physical activity levels and play behaviors. In addition, relationships between activity levels and contextual and play behavior variables (group size, activity type, interactions, temperature, equipment availability, number of supervising adults) were examined using Pearson’s correlations (parametric data) and Spearman’s rho (nonparametric data). All analyses were conducted using the Statistical Package for the Social Sciences v.14 (SPSS Inc, Chicago, IL, USA) and the alpha level was set at P < .05.

Results

One hundred and fourteen children (48 boys, 66 girls; 42% overweight) were observed during the school recesses, and 99 of them (42 boys, 57 girls) wore the uni-axial accelerometer while they were being observed.

Validity

Pearson’s product moment correlation coefficients revealed a moderately positive significant association between estimated energy expenditure scores (2.5 ± 0.5) and mean accelerometer counts (154.5 ± 74.1 CPE; r = .67; P < .01). Higher estimated energy expenditure rates were significantly correlated with higher accelerometer counts.

Physical Activity

Table 1 shows the proportion of time that normal weight and overweight boys and girls spent in the physical activity categories.

### Table 1 Proportion of Time Spent in Physical Activity Categories During Recess (Mean ± SD)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Boys NW (n = 29)</th>
<th>Boys OW (n = 19)</th>
<th>Girls NW (n = 37)</th>
<th>Girls OW (n = 29)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lying down (%)</td>
<td>0.1 ± 0.6</td>
<td>0 ± 0</td>
<td>0.5 ± 3.3</td>
<td>0.5 ± 3.3</td>
</tr>
<tr>
<td>Sitting (%)</td>
<td>5.5 ± 16.7</td>
<td>8.3 ± 11.9</td>
<td>6.1 ± 14.9</td>
<td>10.3 ± 18.7</td>
</tr>
<tr>
<td>Standing (%)</td>
<td>28 ± 17.8**</td>
<td>29.4 ± 14.8**</td>
<td>35.1 ± 18.1**</td>
<td>40.5 ± 18.5**</td>
</tr>
<tr>
<td>Walking (%)</td>
<td>42.3 ± 15.9</td>
<td>42.7 ± 16.7</td>
<td>41.1 ± 16</td>
<td>36 ± 15.2</td>
</tr>
<tr>
<td>Vigorous (%)</td>
<td>24.2 ± 16.1*</td>
<td>19.6 ± 11.1*</td>
<td>17.3 ± 13.7*</td>
<td>12.6 ± 9.3*</td>
</tr>
<tr>
<td>Sedentary (%)</td>
<td>33.6 ± 19.8**</td>
<td>37.7 ± 16.7**</td>
<td>41.8 ± 19.7**</td>
<td>51.6 ± 19.4**</td>
</tr>
<tr>
<td>MVPA (%)</td>
<td>66.4 ± 19.8*</td>
<td>62.3 ± 16.7*</td>
<td>58.3 ± 19.8*</td>
<td>48.6 ± 19.4*</td>
</tr>
</tbody>
</table>

Abbreviations: NW = normal weight; OW = overweight; MVPA = moderate-to-vigorous physical activity.

Note. Totals may not add up to 100 due to rounding.
* Significant difference, P < .01, boys > girls.
** Significant difference, P < .01, boys < girls.
**Sedentary Behaviors.** Girls spent proportionally more recess time in sedentary behaviors than boys (Table 1); no other main effects or sex x BMI group interactions were found.

**MVPA.** Boys engaged in significantly more MVPA than girls (64.8 ± 18.6% vs. 54 ± 20.1%; \( P < .01 \)). The BMI group main effect approached significance (\( P = .06 \)). The sex x BMI group interaction was not significant (\( P > .05 \); Table 1).

**VPA (Vigorous Physical Activity).** Boys engaged in significantly more VPA than girls (22.4 ± 14.4% vs. 15.2 ± 12.1%; \( P < .01 \)). The BMI group main effect approached significance (\( P = .07 \)). The sex x BMI group interaction was not significant (\( P > .05 \); Table 1). The results suggest that children of normal weight tended to engage in more MVPA and VPA than overweight children, though the differences were not statistically significant.

**Social Play Behavior**

**Group Size.** The social group size identified the total number of people in the group in which the target child was located during the observation interval, and it included the target child. Group sizes, based on the findings of Blatchford et al.\(^\text{27}\) were classified as alone (child by his/her self), small (2–4 people), medium (5–9 people), and large (10 or more people). When children were interacting with adult supervisors, the adults were also counted within the group size.

Girls (50.8 ± 29.5%) were observed being in small groups significantly more often than boys (35.6 ± 29.6%) (\( P < .01 \)). Meanwhile, boys (29.6 ± 39.2%) were more often found in large groups than girls (9.7 ± 21.2%; Figure 2)(\( P < .01 \)). There were no significant differences by body weight status in the proportion of time children spent in different sized groups, though Figure 2 suggests that overweight girls tended to be in small groups and spent less time alone. The sex x BMI group interactions were not significant (\( P > .05 \)).

**Activity Type.** Activity type reflects the nature of the playground activity the target child was engaging in when observed. Activity types were classified as sports (eg, soccer, basketball), active games (eg, dodge-ball, chasing games), sedentary activities (eg, reading, playing board games), and locomotion (eg, walking, jogging that was not part of a sport or game).

Boys engaged in significantly more sports related activities than girls (36.9 ± 38.9% vs. 3.5 ± 14.8%; \( P < .01 \)), and girls engaged in significantly more active playground games than boys (46.8 ± 32.5% vs. 21.3 ± 28.8%; \( P < .01 \)) (see Figure 3). There were no significant differences between boys and girls in the proportion of time they spent in sedentary or locomotive activities. The BMI group main effect and sex x BMI group interactions were not significant for any activity type (\( P > .05 \)).

**Interactions.** Interactions reflect the child’s social behavior during an observed interval and were divided into 2 main categories, prosocial and antisocial. Each of these categories was further classified into (a) physical or (b) nonphysical (ie, verbal and nonverbal) response categories.

Girls engaged in more occurrences of positive physical behaviors than boys (22.4 ± 14.6% vs. 11.3 ± 12.4%; \( P < .01 \)). In contrast, boys engaged in more negative physical conflict behaviors (4.7 ± 5.9% vs. 1.6 ± 3.2%; \( P < .01 \)). Boys of normal weight engaged in more verbal conflict (nonphysical) behaviors than overweight boys and girls and girls of normal weight, though this difference was not significant. Figure 4 illustrates that children, regardless of sex or BMI status, engaged in more positive than negative social behaviors.
Figure 3 — Proportion of recess time normal weight and overweight boys and girls spent in different activities.

Figure 4 — Percentage occurrence of social interactions of normal weight and overweight boys and girls during recess. PS = Physical sportsmanship (prosocial physical); VS = Verbal sportsmanship (prosocial nonphysical); PC = Physical conflict (antisocial physical); VC = Verbal conflict (antisocial nonphysical); I = Ignore (ignore negative interaction initiated by another child).
Relationships Between Physical Activity, Play Behavior, and Contextual Variables

Pearson’s product moment correlations revealed significant positive relationships between %MVPA and time spent in sports activities (r = .28; P < .01), being in groups of large size (r = .23; P < .05), and frequency of physical conflict (r = .27; P < .01). Significant negative relationships were found between %MVPA and time spent in sedentary activities (r = –0.54; P < .01) and higher temperatures (r = –0.21; P < .05). %MVPA was not significantly related with the number of adults supervising recess (P > .05). Spearman’s rho correlation revealed that %MVPA was positively associated with the availability of equipment during recess (r = .24; P < .05).

Discussion

Recess is an important setting for children to accrue recommended minutes of health-related physical activity and to interact socially with similar and same-aged peers. Physical activity always occurs within a context, and understanding specific contexts is important when developing programs or interventions. This study, therefore, assessed a direct observation system to simultaneously measure children’s physical activity and play behaviors.

The validity of the physical activity codes used in SOCARP had previously been determined in studies using heart rate monitoring, but they had not been assessed in a field setting using accelerometry. Children’s physical activity levels are characterized by intermittent, spontaneous, and transient activity patterns, and Baquet et al recently reported that 80% of children’s moderate intensity and 93% of their vigorous intensity bouts last fewer than 10 seconds. This study found a moderately positive association between the physical activity codes and accelerometry counts during recess, suggesting that SOCARP is valid for assessing overall physical activity levels in contexts where children’s activity is spontaneous and transient.

Acceptable inter- and intrarated reliabilities for numerous variables were obtained, suggesting that SOCARP can be used reliably by trained observers to collect physical activity levels, group size, play activities and social behaviors in recess contexts. This is an important finding, particularly because of the erratic nature of children’s physical activity patterns. There is a need, however, to assess the system in a variety of additional play and recess contexts and with additional observers to further determine its generalizability and to identify more precisely the amount of time it takes for observers to be trained.

SOCARP enables researchers and practitioners to obtain data concerning children’s physical activity levels and behavior and relationships during play. The study showed boys engaged in more MVPA and VPA than girls, and that boys of normal weight were the most active group, both of which support previous research. However, compared with the finding that normal weight girls were the least active group, this study found that overweight girls were the least active group, spending more time in small groups and engaging in sedentary activities, which were negatively related to %MVPA. Interventions may be needed to target overweight girls’ recess activity, such as providing more equipment to increase the child-to-equipment ratio and active recess games that are suitable for small groups.

It should be noted, however, that the MVPA and VPA scores in this present study were higher than those of previous studies. This may be because the current study assessed children only on the playground, while previous studies examined physical activity across entire recess periods, which included eating lunch and getting to the playground. Despite this, the results suggest that girls and overweight children may benefit from interventions designed to increase physical activity levels during recess. Information provided by SOCARP may be particularly useful in assessing these interventions because the tool specifically assesses relevant contextual variables.

The current study found that girls participated in small groups more frequently than boys and that boys played in larger groups more often. These results support previous research indicating that boys’ social groups tend to be larger than girls. Furthermore, there was a positive association between large group size and MVPA engagement, suggesting that some playground activities accommodate large numbers and keep participants active. Interestingly, the most common group size observed on the playground was the small group, which consisted of 2 to 4 people. Large group activities may encourage higher physical activity, but when designing playgrounds it is also important to consider the provision of opportunities for activities that can be undertaken in small groups so that prefer this format can be accommodated.

Spending time in sports activities was associated with MVPA accrual, and boys spent more time in sports activities than girls. Previous research has suggested that boys tend to engage in more active games and more ball games than girls, while girls engaged in sedentary play (eg, drawing, reading) and conversation more often. The present results illustrated that girls do engage in active playground games during recess, but they may not engage in them at the intensity levels that boys do. The nature of the activities played may also explain this finding. Playground games are often characterized by taking turns and other cooperative behaviors, but children are not necessarily very physically active when doing this.

It should be noted that SOCARP assesses the availability of portable equipment using a “yes/no” classification. Some equipment was provided during most recess periods, so it may be also important to assess the amount and type of equipment more precisely. In addition, in the current study adult supervisors were included in the count for determining group size. In the future if may be more relevant to count children only. Nonetheless, despite these potential limitations, SOCARP provides...
pertinent information on variables associated children’s physical activity levels.

Antisocial behavior such as bullying and fighting during playtime has been reported to be a major concern for elementary schools. Indeed, lunchtime has been described as the biggest behavioral problem faced by school staff during the day. This study found that while negative interactions did occur among children, positive interactions were more likely to take place, regardless of BMI group and particularly among girls. Instances of negative social interactions were more common among boys, and increased incidents of physical conflict were associated with higher MVPA. This may be attributable to boys playing more sports activities, which are competitive in nature and offer increased opportunities for collisions and disputes. It may also be because boys tend to engage in more rough and tumble play, which is vigorous in nature and has the potential for negative social interactions such as pushing and grabbing which are a standard part of these games.

Conclusions

This study documented that that SOCARP is a valid and reliable observation system for recording physical activity levels and play behaviors during recess. The instrument permits the simultaneous assessment of variables that can influence the physical activity engagement, while providing information on both the physical setting and the dynamic nature of the social environment. While the generalizability of SOCARP to other play settings requires further assessment, it is a useful tool for evaluating children’s activities and relationships during recess.

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